IMPROVING HEALTH PROFESSIONALS' ACCESS TO INFORMATION:

CHALLENGES AND OPPORTUNITIES FOR THE NATIONAL LIBRARY OF MEDICINE

**Report of the Outreach Planning Panel
to the Board of Regents of the
National Library of Medicine**

May 1989

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Outreach Planning Panel
Michael E. DeBakey, M.D., Chairman
Report to the Board of Regents
of the
National Library of Medicine

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Executive Summary

With the rapid expansion of scientific knowledge in the years following World War II, it was recognized by the early 1960's that the vast amount of new biomedical information was not reaching those people who needed it: researchers, educators, and especially the practicing health-care provider. Indeed, while many medical centers had developed into noteworthy generators of basic and clinical research, the health sciences libraries in many of these centers had been woefully neglected. They were crowded and makeshift, with too few trained librarians, insufficient automation and few programs for sharing resources.[1]

In 1965, the President's Commission on Heart Disease, Cancer, and Stroke, chaired by Dr. Michael DeBakey, set as a goal *"to achieve fingertip control of the literature, of all that is known about the causes, treatment, and prevention of heart disease, cancer, and stroke, and to make this knowledge available to researchers, educators, and practitioners."*[2]

The Medical Library Assistance Act (MLAA) of 1965 was enacted to help fulfill this responsibility. With the resources provided by the MLAA, the National Library of Medicine (NLM) and the Nation's medical libraries together have made great strides in the intervening years: previously inadequate medical libraries have expanded and improved their facilities; new libraries have been built; strong collections of books and journals have been developed; professional librarians have been trained; resource sharing has been formalized through the Regional Medical Library (RML) network; and

new information technologies have been introduced to automate key library services.

NLM has been at the forefront in the development of new information technology in the health sciences. NLM's MEDLARS®/MEDLINE® network of computerized databases contains more than ten million references to the world's biomedical literature, and provides thousands of health researchers, educators, practitioners, and students immediate access to needed information on a daily basis. The highly successful networking of these online databases has been supported by the nation's medical libraries.

Today, in 1989, we are faced with new challenges as critical as those of the 1960's. A strong library network has been built, yet many health professionals, perhaps the majority, are unaffiliated with a medical library and thus do not have ready and timely access to the vital health information they need. With the availability of advanced personal computers and increasingly good public communications networks, the time has come to reach out to include all individual American health practitioners and to see that they have ready access to NLM's information services.

Congress has recognized this need. In 1987, it encouraged NLM *"... to develop an outreach program aimed at ...[the] transfer of the latest scientific findings to all health professionals... in rural communities and other areas ..."*.[3] The mission of the NLM was explicitly amended to add the function to *"Publicize the availability of [its] products and services..."*.[4]

In response to this charge, the NLM Board of Regents convened a Planning Panel on Outreach expressly for the purpose of formulating a plan to guide the Library's efforts to improve access to its information services by every American health professional in all settings. The Regents sought a

1. Bunting A, DeBakey ME, Davies NE, Messerle J, Palmer R. Medical Library Assistance Act: a twenty-year review. In: National Library of Medicine. *Locating and gaining access to medical and scientific literature; report of NLM Board of Regents Long Range Planning Panel 2. Bethesda, Md.: National Library of Medicine, December 1986;32-49.*

2. U.S., President's Commission on Heart Disease, Cancer, and Stroke. *Report to the President: a national program to conquer heart disease, cancer, and stroke; vol. 2. Washington: Government Printing Office, 1965;326.*

3. U.S., Congress, Senate, Committee on Appropriations, *Departments of Labor, Health and Human Services, and Education and Related Agencies Appropriation Bill, 1988: Report to Accompany H.R. 3058*, 100th Cong., 1st sess., 1987, S. Rept. 100-189, p. 138.

4. U.S., Congress, *Joint Resolution Amending the National Library of Medicine Act*, Public Law 100-202, section 215, 1987.

plan that would address the need to increase the awareness of prospective users; suggest strategies for removing obstacles to access; and propose mechanisms to ensure the maximum relevance of NLM's diverse array of information products and services. This document is such a plan.

The panel met three times during late 1988 and early 1989. Its chair is Dr. Michael DeBakey, a long time proponent of improved medical information services and the former chairman of the 1965 President's Commission on Heart Disease, Cancer, and Stroke. The membership is comprised of leading medical educators, health professionals, scientists, medical librarians, and representatives of the business community.

This Report sets forth the Panel's major findings in four major categories, each followed by specific actions recommended to NLM and the Panel's calculation of financial and personnel requirements.

1. The Individual and the Regional Medical Library (RML) Network

The Challenge. Under the MLAA authority, the highly successful RML Network overcame the problems of resource building and sharing among institutions. It is now necessary and appropriate to move into the next phase, that of reaching *individual* health professionals and including them in the activities of the Network.

Recommended Action. *NLM and the RMLs should build a more active partnership for the RML Network, one that will be flexible and permit rapid response to regional needs, geographic factors and changing environmental conditions. The emphasis of the RML Program should be to bring biomedical information resources within easy reach of all health professionals, especially those individuals in areas that do not currently have direct access. To do this, the RMLs should act as a "field force" for NLM products and services, providing information and services to health professionals directly and through network*

libraries, and providing feedback from health professionals to NLM.

Recommended Resources. The Panel estimates that an increment of $2 million in FY 1990, increasing to $6 million in FY 1991, is required to enable the RMLs to marshal the resources necessary to reach individual health professionals, to gather specific observations on their information needs, and to demonstrate the use of existing relevant information products and services.

In addition to the current staff, NLM should be permitted to add three persons to its staff to coordinate these programs.

2. Strengthening Hospital Access to National Information Sources

The Challenge. Information resources at a national and international level are growing at a faster rate than the ability of local medical libraries and medical institutions to use them. Shrinking library holdings and collections at the local level, the lack of communications specialists in smaller institutions, and the scarcity of appropriate communications equipment and computers locally are creating a grave danger of isolation of local medical facilities from the growing national information capability.

Recommended Action. *NLM should strengthen and facilitate local institutions' access to national biomedical information sources by:*

■ *Assisting local institutions in gaining access to networks by substantially expanding its extramural resource grant program of "Access" grants.*

■ *Seeking substantially increased funding for the Integrated Academic Information Management Systems (IAIMS) Program to assist a larger number of institutions that are planning for integrated information services, and to insure sufficient models to accommodate the diversity of IAIMS sites. Present Phase I and Phase II programs (that promise*

*new models for implementation) should
be brought to completion; and, most
important, Phase III implementation
projects should be supported. Funding
in subsequent years should support
meritorious new applications and
proposed models at levels equal to those
originally planned.*

■ *Assuring biomedical participation in
current NSFNET developments and in
planning for future advanced electronic
communications networks to assure
health professionals' access to
biomedical information.*

Recommended Resources. In FY 1990
enhanced access to national information sources by
institutions at the local level requires incremental
funding totalling $9 million, consisting of $2 million
in additional resource access grants, $6 million for
the IAIMS program, and $1 million for biomedical
participation in advanced networks.

In addition to the current staff, NLM should be
permitted to add three persons to its staff to
coordinate these programs.

3. Training in Health Information Management

The Challenge. There are not adequate numbers
of persons in the biomedical fields who have had
training in the use of modern computer and
communications systems. There is a need both for
biomedical professionals cross-trained in informatics
and for persons from computer and information
sciences and engineering who have had doctoral or
post-doctoral training in the application of these
technologies to health problems. Even the major
university medical centers that have concentrated
their resources on planning for institution-wide
information services have found that locating and
recruiting senior professionals with this kind of
education and training is their greatest obstacle.

Recommended Action. *NLM should
substantially increase the number of
Medical Informatics training centers,
individual awards for research training and
career development, and demonstration
grants.*

Recommended Resources. $10 million is
required in FY 1990 for funding additional training,
fellowships, and demonstration grants.

In addition to the current staff, NLM should be
permitted to add one person to its staff to coordinate
these programs.

4. A New Generation of Information Products and Services

The Challenge. NLM's current products and
services serve the health professions very well, but
more are necessary. Recent improvements have
included:

■ 24-hour access to online databases

■ GRATEFUL MED® front-end search system for
health professionals' personal use

■ Improved interconnections between numerous
databases

■ **Elimination of monthly minimum charges,
introduction of reduced charges for students,
and increased flexibility in arrangements for
MEDLINE use by educational and research
institutions**

■ Establishment of DOCLINE® nationwide to
facilitate interlibrary borrowing of medical
literature

■ AIDSLINE® and other special information
services in response to national initiatives
against this epidemic.

These are excellent examples of NLM's
responsiveness to changing needs. In addition,
however, NLM should put in place a system to
monitor continuously the actual use of its products

and services at the level of individual health practitioner, student and researcher. Furthermore, it should establish a continuous "production line" of improved information products and services that are immediately responsive to the needs so identified. This research and development production line should be in addition to the more long range, basic research in which NLM is already engaged.

Recommended Action. *NLM should accelerate intramural R&D on products and services that are optimally responsive to the information needs of health professionals by:*

■ *Placing a high priority on research to ascertain the information requirements of U.S. health professionals, the suitability of current means for acquiring health-related information, and impediments to such acquisition. Using these data, NLM should mount a national campaign to increase awareness of its information products and services among all health professionals in all settings, and put in place permanent feedback mechanisms to ensure their optimal utility.*

■ *Expanding and enhancing intramural research and development programs leading to the improvement of current information products and services and the creation of new systems.*

Recommended Resources. It is estimated that incremental R&D funding totalling $5 million is required in FY 1990 to ensure NLM's continued ability to offer needed products and services, approximately $2 million for user studies and $3 million for product development.

In addition to the current staff, NLM should be permitted to add 10 persons to its staff to do this research and development.

Staffing

This report recommends significant additional responsibilities and funding for the NLM. It is imperative that NLM obtain additional FTEs that will provide the minimum level of staff support necessary to undertake recommended initiatives as specified. Seventeen FTEs are required in FY 1990 to provide staffing for implementation of this plan's recommendations for improved access in the four specific areas described. This number represents the total of those additional personnel that are specified for each of the major recommendations.

This recommendation for FTEs does not take into account the other obligations of NLM not reviewed at this time. Specifically, it does not include additional FTEs required for the Congressionally mandated National Center for Biotechnology Information and those needed to respond to the increasing volume of literature and service requests.

Improving Health Professionals' Access to Information

The concept of ready access to a comprehensive store of recorded knowledge has for centuries tantalized the scholar and investigator. To achieve fingertip control of the literature, of all that is known about the causes, treatment, and prevention of heart disease, cancer, and stroke, and to make this knowledge available to researchers, educators, and practitioners, is an objective to which this Subcommittee wholeheartedly subscribes. Traditionally, the medical library plays the central role in the interchange of published biomedical information.[5]

Dr. Michael DeBakey, Chairman, President's Commission on Heart Disease, Cancer, and Stroke, 1965.

Introduction: The Problem of Access

A little over two decades ago, the medical libraries of this Nation were unable to provide effective access to the results of biomedical research. Recognizing this, the President's Commission on Heart Disease, Cancer, and Stroke noted in 1965 that:

> *The marshaling of resources, public and private, to insure better health for the American people has been a phenomenon of the post-World War II decades....Attention has been called repeatedly to a significant exception to this commendable development. Those problems which are associated with the communication of new scientific knowledge, both to researchers who must use it still further to explore the unknown, and to practitioners who must have access to it to improve the Nation's health, are so critical as to warrant our most serious attention.*[6]

The Commission recommended that:

> *The National Library of Medicine should support and assist the development of improved medical library services in the United States by an extramural program acting through grants and contracts in areas of medical library facilities, resources,*

personnel, and secondary publications. The Library should also conduct forward-looking research and development for the purpose of increasing the effectiveness of medical library service throughout the Nation.[7]

Much has been accomplished by the National Library of Medicine in the intervening years. With assistance provided under authority of the 1965 Medical Library Assistance Act, medical libraries have expanded and improved their facilities; new libraries have been built; strong collections have been developed; staffs have been trained; shared programs among libraries has been formalized through the Regional Medical Library network; and new information technologies have been introduced to automate key library services.

Many of these technologies have stemmed from the general advances of information science and computers, tailored or adapted to the needs of health care. Other improvements have emanated from the research and development laboratories of the NLM. Foremost among them has been the MEDLARS/MEDLINE network of computerized databases containing more than ten million references to the world's biomedical literature. Every day, thousands of health researchers, educators, practitioners, and students access these databases and obtain needed information through the services of medical libraries. The networking of these online databases, supported by the nation's medical libraries

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5. President's Commission, *Report to the President*, p. 326.

6. President's Commission, *Report to the President*, p. 381.

7. President's Commission, *Report to the President*, p. 385.

with NLM at the apex of a broad national pyramid , has been a great success.

Today in 1989 we are faced with new challenges as critical as those of the 1960's. A strong library network has been built, yet many health professionals, perhaps the majority, are unaffiliated with a medical library and thus do not have ready and timely access to the vital health information they need. With the availability of advanced personal computers and increasingly good public communications networks, the time has come to reach out to include all individual American health practitioners and to see that they have ready access to NLM's information services. Congress has recognized this need.

In October 1987, the Senate Committee on Appropriations, in its report on the Departments of Labor, Health and Human Services, and Education and Related Agencies Appropriation for 1988, stated in its section on NLM:

> *The Nation's immense investment in*
> *biomedical research can be maximized*
> *only if there are efficient channels for*
> *disseminating research results, and these*
> *the library provides through its*
> *computerized MEDLARS services and the*
> *regional medical library network. The*
> *Committee believes that this program*
> *should be expanded to reach all American*
> *health professionals, wherever located, so*
> *they will be able to take advantage of the*
> *library's information services. The*
> *Committee encourages the NLM to*
> *develop an outreach program aimed at*
> *science and technology transfer of the*
> *latest scientific findings to all health*
> *professionals including psychologists,*
> *nurse midwives, and nurse practitioners*
> *in rural communities and other areas...*[8]

In December 1987, the National Library of Medicine Act was amended to add to the functions of the Library:

> *Publicize the availability of the above*
> *products and services of the National*
> *Library of Medicine.*[9]

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8. Senate, *Appropriation Bill, 1988*, p. 138.

9. Congress, *National Library of Medicine Act*.

In 1988, the Senate Committee on Appropriations affirmed the importance of increasing the Library's outreach and access programs, and expressed concern

> *that hospitals undergoing financial*
> *hardship, especially small rural hospitals,*
> *may be unable to commit scarce resources*
> *to maintaining their libraries...and...that*
> *health care professionals...in isolated*
> *areas, who are most likely to lack access*
> *to recent scientific and technological*
> *findings, are also least likely to have*
> *access to such libraries.*[10]

The Committee requested

> *that the NLM develop an active outreach*
> *program to disperse this information to*
> *rural and remote health care*
> *professionals, and devise a method of*
> *notifying these professionals of the*
> *availability of up-to-date information.*[11]

In response to this charge, the NLM Board of Regents' Planning Subcommittee convened a Panel on Outreach expressly for the purpose of formulating a plan to guide the Library's efforts to improve access to its information services.[12] The Panel is chaired by Dr. Michael DeBakey, a long-time proponent of improved medical[13] information services and the former chairman of the 1965 President's Commission on Heart Disease, Cancer, and Stroke. The Regents sought a plan that would address the need to increase the awareness of

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10. U.S., Congress, Senate, Committee on Appropriations, *Departments of Labor, Health and Human Services, and Education and Related Agencies Appropriation Bill, 1989: Report to Accompany H.R. 4783*, 100th Cong., 2d sess., 1988, S. Rept. 100-399, p. 145.

11. Ibid.

12. The Outreach Panel is composed of 31 leading medical educators, scientists, health professionals, medical librarians, and marketing specialists (see Appendix for panel roster). The Panel met three times between November 1988 and March 1989.

13. In this report "medical" is meant to be generic and inclusive of all health professions.

prospective users; suggest strategies for removing obstacles to access; and propose mechanisms to insure the maximum relevance of NLM's diverse array of information products and services. A new and revitalized partnership with the Regional Medical Library Network has emerged as the backbone of the plan; and modern computer and information technology is the sinew that gives it strength.

The Panel's recommendations, along with estimated incremental budget requirements (using FY 1989 as a base), are presented in the following sections:

■ The individual and the RML network.

■ Strengthening hospital access to national information sources through resource grants to small hospital libraries, support for the Integrated Academic Information Management Systems (IAIMS) program, and participation in the emerging national electronic communications networks, such as NSFNET.

■ Expanding training, fellowships, and demonstration grants.

■ Expanding intramural R&D at NLM, including studies about the users and uses of its products and services, and the development of new or enhanced information products and services to meet the needs of health professionals.

Findings

1. The Individual and the Regional Medical Library Network

The Challenge. The RML Program, funded under the Medical Library Assistance Act and its subsequent renewals, has played a vital role in improving access by creating a functioning network of medical libraries serving all fifty states. The networking of medical libraries was a success; the next step, not accomplished to date, is for NLM and all of the libraries in the RML network (RMLs, resource libraries, and local libraries) to establish direct contact with the whole spectrum of health professionals who are the ultimate users of biomedical information services, thus

incorporating the *individual* health practitioner within the *institutional* network.

Regional Medical Library Network
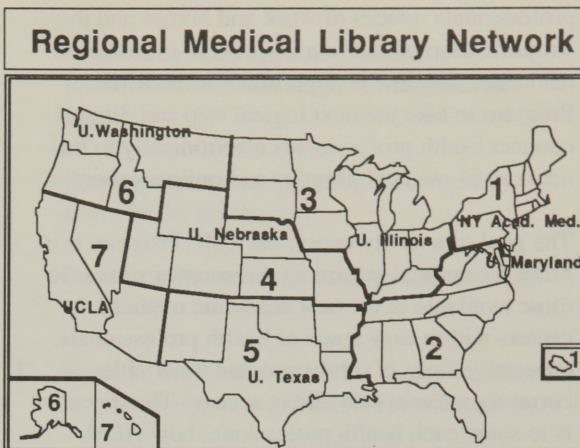
Twenty years' experience has proved the soundness of the strategy that led to the development of a national system of RMLs, each with facilities of sufficient depth and scope to support the services of other medical libraries in the region it serves, and providing health professionals with effective, timely access to biomedical information. A new and revitalized RML Program must offer high quality products and services that satisfy all health professionals' needs, efficiently and at a reasonable cost, and that continue to serve an everchanging market. In a new alliance, RMLs and the libraries in their regions can act as representatives and agents for NLM information products and services. Under NLM leadership, the RMLs must be able to assist NLM in developing such products and services and in creating a marketing strategy and "field force" for distributing them. The RMLs and their constituent libraries will also supply NLM with feedback and information concerning how information is being used, new ideas for products and services, etc. Information and ideas should flow both out from NLM through the RMLS and network libraries to health professionals, and back the other way. A two-way communications process is needed.

Today, nearly 3,000 medical libraries have identified themselves as RML network members and have agreed to provide services to help health professionals identify, locate, and obtain needed information. Most, but not all, are connected in

this network by terminals and microcomputers, and a growing number by telefacsimile machines. Because of the widespread availability of these increasingly sophisticated devices in health professionals' places of work and homes and the simplification of electronic access to information resources, the time is opportune for the RML Program to take the next logical step and directly connect health professionals electronically to this network of medical libraries and online resources.

The goal of a newly energized RML Program is to bring biomedical information resources similar to those available in the best academic medical centers within easy reach of health professionals, especially those in rural areas and inner cities currently without easy direct access. The objective is to show each health professional how NLM systems might improve his or her access to biomedical information. Staff in network libraries will initially explain available resources and the systems used to access them, and subsequently will be available to provide assistance and obtain suggestions for improvements or new products. The RML Program will be able to initiate innovative programs and new uses of the network.

The RML Program will depend on the programs and services of NLM, a major regional biomedical library resource in each region, a small staff in each of these regional libraries to provide coordination and outreach activities, and the thousands of medical libraries in the network. These library resources in the network should continue to be strengthened, their staffs trained to use the systems and reach users, and the systems connecting them strengthened. Each health professional should have the opportunity to connect to the most comprehensive up-to-date biomedical information systems in the world.

Recommended Action. *NLM and the RMLs should build a more active partnership for the RML Network, one that will be flexible and permit rapid response to regional needs, geographic factors and changing environmental conditions. The emphasis of the RML Program should be to bring biomedical information resources within easy reach of all health professionals, especially those individuals*

in areas that do not currently have direct access. To do this, the RMLs should act as a "field force" for NLM products and services, providing information and services to health professionals directly and through network libraries, and providing feedback from health professionals to NLM. The Panel estimates that an increment of $2 million in FY 1990, increasing to $6 million in FY 1991, is required to enable the RMLs to marshal the resources necessary to reach health professionals, to gather specific observations on their information needs, and to demonstrate the use of existing relevant information products and services.

Following are the detailed actions that will accomplish this recommendation:

A.   Assist in connecting health professionals to the RML Network by:

Making them aware of available information resources, methods of accessing them, and ways they can be useful;

Promoting NLM products;

Conducting and publicizing training classes;

Providing a means for health professionals unaffiliated with a library to request the loan of books and journal articles ("document delivery");
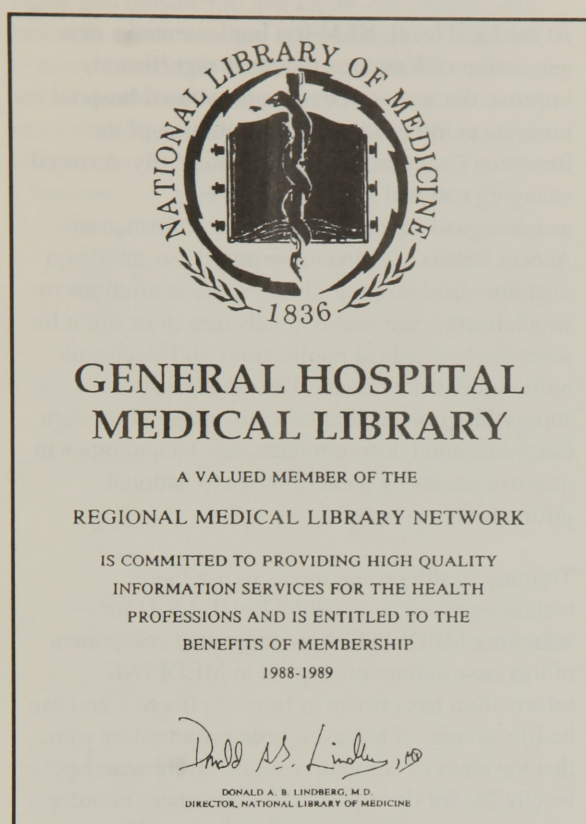
Implementing high-speed electronic systems to improve document delivery to users;

Developing and maintaining regional information resource files;

Providing user support through expansion of the existing NLM online service desk; and

Conducting evaluation studies and needs assessments to provide NLM with information on and suggestions for new NLM products and

services, and on the use of information by health professionals.

GENERAL HOSPITAL MEDICAL LIBRARY

A VALUED MEMBER OF THE

REGIONAL MEDICAL LIBRARY NETWORK

IS COMMITTED TO PROVIDING HIGH QUALITY INFORMATION SERVICES FOR THE HEALTH PROFESSIONS AND IS ENTITLED TO THE BENEFITS OF MEMBERSHIP

1988-1989

Donld A.B. Lindley, MD

DONALD A. B. LINDBERG, M.D.
DIRECTOR, NATIONAL LIBRARY OF MEDICINE

B. Improve the capabilities of the libraries in the network by:

Expanding services to strengthen libraries that are not operating as full network members;

Strengthening the network links among health science libraries to assist them in becoming NLM's "field force" in introducing health professionals to NLM products and services;

Evaluating new NLM systems and databases as they become available; and

Collecting data on the network libraries to determine trends and significant changes in their ability to assist health professionals.

C. Encourage technology transfer and research by:

Introducing the use of and evaluating new NLM products and services in operational (i.e., health care) environments;

Disseminating information about the latest technology developments to health information providers and health professionals;

Facilitating and supporting medical informatics research efforts throughout the region;

Serving as resource points for information about NLM grants; and

Providing an annual technology update from NLM.

D. Improve the RML Network's ability to serve increased numbers of health professionals by:

Reviewing the current RML mission and goal statements for possible modifications to emphasize the Network's increasing role in actively reaching health professionals;

Studying the configuration of the RML Network, in light of its new emphasis, for possible modification;

Reviewing the name of the network for possible emphasis on its national nature;

Improving the understanding of each RML Regional Advisory Committee of national services and priorities;

Improving the communications among network members and with NLM.

Recommended Resources. The following table shows recommended appropriations to strengthen the RML Program. Although additional funds are required in FY 1990 for the planning and contract award phases, the major increment is scheduled for FY 1991 because of the timing of the RML contract cycle.

Incremental Dollars in Millions					
Regional Medical Library Network					
	FY 90	FY 91	FY 92	FY 93	FY 94
Assist in connecting health professionals					
	$1.0	$2.0	$2.2	$2.5	$3.0
Improve capabilities of libraries in network					
	0.0	1.5	1.6	2.0	2.0
Encourage technology transfer/research					
	0.0	2.0	2.2	2.5	2.5
Improve ability to serve more health professionals					
	1.0	0.5	0.5	0.5	0.5
Total					
	$2.0	**$6.0**	**$6.5**	**$7.5**	**$8.0**
FTEs[14]					
	3	3	3	3	3

2. Strengthening Hospital Access to National Information Sources

The Challenge. Information resources at a national and international level are growing at a faster rate than the ability of local medical libraries and medical institutions to use them. Shrinking library holdings and collections at the local level, the lack of communications specialists in smaller institutions, and the scarcity of appropriate communications equipment and computers locally are creating a grave danger of isolation of local medical facilities from the growing national--and even international--information capability.

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14. Here and throughout the report, "FTEs" refers to Full-Time Equivalents, or additional staff required. FTE levels are shown as increments above the FY1989 base, and are not cumulative.

Resource Grants to Small Hospital Libraries

At the local level, NLM has implemented a new generation of Resource Grants to significantly improve the access of community-based hospital libraries to information. The evolution of the Resource Grant Program has consistently mirrored changing national needs and evolving technological capabilities. Today, Information Access Grants are directed primarily to small and medium-sized hospital libraries, the institutions to which health-care professionals turn most often for access to biomedical publications and electronic bibliographic databases. The emphasis is on supporting projects that take advantage of modern electronic and telecommunications technologies to improve access by local libraries to national information resources.

Training health professionals to use these technologies, such as GRATEFUL MED for searching MEDLINE, is an important component of this new initiative. Access to MEDLINE information has proven to be cost-effective and can be life-saving. It has even been proposed by some that the costs of computerized literature searches be eligible for third-party reimbursement in order to encourage their more widespread use.[15]

Successful "Access" grant projects will serve as models that can be used by other community-based institutions; they must be funded at a level that will enable this vital leverage to occur.

Integrated Academic Information Management Systems (IAIMS)

In 1983, NLM launched a major initiative in institution strengthening-- the IAIMS Program. It sought to catalyze a new computer-supported information management environment in biomedical teaching and research institutions. Funding is directed toward the institution-wide use of communications and information processing

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15. Davies NE, DeVierno, AA. Reimbursement for computer-assisted literature searches for patient care [Letter to the Editor]. *N Engl J Med* 1988;319(15):1021.

technologies to link and relate library systems with individual and institutional databases and files--inside and outside the institution--for patient care, research, education, and administration. The goal is to create an organizational mechanism within health institutions to manage biomedical knowledge more effectively, and to provide for a system of comprehensive information access. A related goal is to strengthen and to position the institutional libraries to assume crucial and evolving functions in a new information-intensive era. The program requires an institution to follow three sequential phases: I.) a planning phase of about two years; II.) a prototyping phase (of about three years) to explore and introduce technologies; and III.) an implementation phase of five years to introduce a networked and coordinated information and communications program. The original funding formula envisioned twenty Phase I planning grants; ten Phase II prototype development grants; and five Phase III full scale implementations. To date, seven institutions have been funded at the Phase I level, five at Phase II, and two at Phase III.

In 1988, NLM assembled a grants review committee to evaluate several of the IAIMS applications and to appraise the status of the program. The committee's report was an enthusiastic reaffirmation of the IAIMS concept, not only in achieving considerable information integration but also in catalyzing important changes in institutional behavior. There is no single IAIMS model: the unexpectedly diverse implementations reflect the wide differences in institutions. A principal barrier to an even more complete realization of the IAIMS concept has been inadequate funding which, in the current fiscal year, has permitted the support of only two institutions at the third and final implementation phase, with no new awards to institutions planning an IAIMS program (Phase I), or developing a prototype (Phase II).

The Outreach Panel is impressed with the success of the IAIMS Program in improving information access for institution-based health professionals. The Panel strongly endorses and supports the recommendations contained in the review committee's report and the need to capitalize on the program's successes to date.

Participation in National Networks

Strengthening access to national information sources must include building connections to the developing national networks--the interstate "highways" capable of carrying electronic information "traffic" to all health professionals in all settings. Rural practitioners may experience isolation from the mainstream of American medicine. They face high communications costs that cannot be offset by high volume links in low population densities; in fact, there are no nodes for high speed value-added networks (VANs) in small towns. At the other extreme, urban health professionals, who may routinely need to access information from numerous workplaces and several different computer systems, are prime candidates for a technological solution. Electronic gateways and networks, computers linking users' computers to other computers, automatically and invisibly, represent a breakthrough in automation that can be applied to keep the health professional in touch with knowledge as he or she moves from task to task, database to database, setting to setting.

The idea that the nation's scientists ought to be linked in a master computer network--to each other, to computing power, and to information sources--is not a new one. The ready acceptability of personal computers now makes this possible, but coordinated planning of hardware, software, and communications protocols is necessary. There are many institutional, regional, and national networks. Some of these networks, including ARPANET (the Department of Defense research network), BITNET (a national network of computers at universities and research organizations), and NSFNET (sponsored by the National Science Foundation), are part of a collection of inter-connected networks called Internet.

NSFNET is to be the national research network. It includes the NSFNET backbone, several mid-level networks, including the network linking the five NSF-funded supercomputers and some regional networks, and campus networks. NSF has taken informal "lead agency" responsibility to design a future network that will have the additional capacity for transmission of images. NLM should participate in this planning, so as to ensure fulfillment of the biomedical community's need for access to these advanced communications

networks and to reflect biomedical priorities as the design options are taken.

Recommended Action. *NLM should strengthen and facilitate local institutions' access to national biomedical information sources by:*

■ *Assisting local institutions in gaining access to networks by substantially expanding its extramural resource grant program of "Access" grants. This support program should be undertaken at a level not less than an additional $2 million in FY 1990.*

■ *Seeking substantially increased funding for the IAIMS Program to assist a larger number of institutions that are planning for integrated information services, and to insure sufficient models to accommodate the diversity of IAIMS sites. Present Phase I and Phase II programs (that promise new models for implementation) should be brought to completion; and, most important, Phase III implementation projects should be supported. Funding in subsequent years should support meritorious new applications and proposed models at levels equal to those originally planned. Incremental funding at a level of $6 million in FY 1990 is essential.*

■ *Assuring biomedical participation in current NSFNET developments and in planning for future advanced electronic communications networks to assure health professionals' access to biomedical information. Incremental funding at a level of $1 million in FY 1990 is required.*

Following are the detailed actions that will accomplish this recommendation:

A. IAIMS grants: fund an additional thirteen Phase I, five Phase II, and five Phase III awards in FY 1990, for a total of twenty Phase I awards, ten Phase II awards, and seven Phase III awards by FY 1994.

Actual and Recommended IAIMS Awards			
Phase	I	II	III
Original goal	(20)	(10)	(5)
Actual No. through FY 89	7	5	2
New Awards FY 90-94	13	5	5
Total # Recommended through FY 94	20	10	7

B. Implement a formal program to support the training of IAIMS professionals with the requisite technical expertise and organizational skills to accept IAIMS leadership roles at their institutions.

C. Encourage and support the exchange of information among current IAIMS participants. The expansion of the IAIMS symposium series is one way of doing this.

D. Establish linkages to connect academic health science centers to existing national scientific and educational networks such as NSFNET.

E. Through national networks, develop an electronic gateway function that will link users of NLM databases in all settings to information in a variety of relevant databases.

Recommended Resources. To summarize resources required for strengthening hospital access to national information sources:

Incremental Dollars in Millions

Strengthening Hospital Access to National Information Sources

	FY 90	FY 91	FY 92	FY 93	FY 94
Resource Grants	$2.0	$3.0	$4.0	$5.0	$6.0
IAIMS					
Phase I/II/III awards	5.0	6.0	7.0	8.0	9.0
Training	0.5	0.5	0.5	0.5	0.5
Information interchange	0.5	0.5	0.5	0.5	0.5
Subtotal, IAIMS	6.0	7.0	8.0	9.0	10.0
National Networks	1.0	1.5	2.0	2.5	2.5
Total	**$9.0**	**$11.5**	**$14.0**	**$16.5**	**$18.5**
FTEs	3	3	3	3	3

3. Training in Health Information Management

The Challenge. There are not adequate numbers of persons in the biomedical fields who have had training in the use of modern computer and communications systems. There is a need both for biomedical professionals cross-trained in informatics and for persons from computer and information sciences and engineering who have had doctoral or post-doctoral training in the application of these technologies to health problems. Even the major university medical centers that have concentrated their resources on planning for institution-wide information services have found that locating and recruiting senior professionals with this kind of education and training is their greatest obstacle. Training in health information management skills is critical. Schools of the health professions must recognize the need for, and support a career path for, informatics-trained persons in their own institutional settings. NLM's role is to expand its successful (pre-doctoral and post-doctoral) grants program for career training in medical informatics. In addition, NLM needs to expand its support of demonstration grants, focusing on extramural research to improve access to biomedical information.

Recommended Action. *NLM should substantially increase the number of Medical Informatics training centers, individual awards for research training and career development, and demonstration grants at an incremental first-year cost of $10 million.*

Following are the detailed actions that will accomplish this recommendation:

A. Expand institutional support for young investigators through the First Independent Research in Support of Transition (FIRST) awards and Research Career Development Awards (RCDA) for more established investigators.

B. Expand the number of competitive post-doctoral fellowship awards made directly to

persons for use at universities of their choosing.

C. Increase immediately the number of NLM training programs in medical informatics from eight to fifteen institutions, with a gradual increase to a total of twenty institutions receiving such support.

D. Expand support for demonstration and research grants in medical informatics, with particular emphasis on systems or methods to improve access to biomedical information.

Recommended Resources. The following table recommends appropriations needed to expand support for Training, Fellowships, and Demonstration Grants:

Incremental Dollars in Millions				
Training, Fellowships, and Demonstration Grants				
FY 90	FY 91	FY 92	FY 93	FY 94
FIRST and RCDA awards				
$1.0	$1.2	$1.4	$1.6	$1.8
Post-doctoral fellowships				
1.5	1.8	2.1	2.4	2.7
Training programs				
2.5	3.0	3.5	4.0	4.5
Demonstration grants				
5.0	6.0	7.0	8.0	9.0
Total				
$10.0	**$12.0**	**$14.0**	**$16.0**	**$18.0**
FTEs 1	1	1	1	1

4. A New Generation of Information Products and Services

The Challenge. NLM's current products and services serve the health professions very well, but more are needed. Recent improvements have included:

■ 24-hour access to online databases

■ GRATEFUL MED front-end search system for health professionals' personal use

■ Improved interconnections between numerous databases

■ Elimination of monthly minimum charges, introduction of reduced charges for students, and increased flexibility in arrangements for MEDLINE use by educational and research institutions

■ Establishment of DOCLINE nationwide to facilitate interlibrary borrowing of medical literature

■ AIDSLINE and other special information services in response to national initiatives against this epidemic.

These are excellent examples of NLM's responsiveness to changing needs. In addition, NLM should put in place a system to monitor continuously the actual use of its products and services at the level of individual health practitioner, student and researcher. Furthermore, it should establish a continuous "production line" of improved information products and services that are immediately responsive to the needs so identified. This research and development production line should be in addition to the more long range, basic research in which NLM is already engaged.

User Studies

At its most fundamental level, an Outreach Plan must specify the means to create awareness among the Nation's health professionals that there are

excellent-- and extremely valuable--information products and services available from NLM. These services, however, will remain unknown to many unless an effective marketing field force can be created. NLM has a variety of activities to publicize its services, including exhibits, brochures, videos, and television public service announcements. Publicity efforts must be greatly increased in number and scope if the health professional community is to realize the extensive benefits of using the latest biomedical information available directly from NLM and its network of medical libraries. As a first step to increasing awareness, NLM must identify impediments to the use of computerized biomedical databases--be they technical, behavioral, or financial--especially among health professionals engaged in patient care.

A well-conceived program of user studies would build upon the excellent efforts already under way, such as the Library's innovative use of the Critical Incident Technique to study the impact of MEDLINE-derived information on the professional practice of medicine. A recent survey of the information practices and needs of health-care providers in rural North Dakota[16] establishes important baseline measures for assessing the impact of prototype outreach intervention in rural communities. The establishment of permanent feedback mechanisms to assess user satisfaction with current systems and to advise on the need for enhancing current systems and developing new ones should be encouraged. An exemplar of the Library's current efforts to create such user linkages is the "efficacy tester" panel of health professionals that guides the continuing development of GRATEFUL MED, NLM's highly successful software program for searching MEDLINE. Evaluation studies and user panels of this kind not only point the way to the development of optimally designed products that are truly responsive to the needs of users, but they can also contribute significantly to our intellectual understanding of the scientific communications process that, ultimately, succeeds or fails in

transferring the results of biomedical research from the bench to the bedside.

New Products and Services

In 1965, recognizing the enormous potential of research in improving information services for health professionals, the President's Commission on Heart Disease, Cancer, and Stroke found that

> *Of paramount importance is the conduct of an intramural research and development program to explore and exploit new technologies for more efficient management of the world's biomedical literature.*[17]

NLM has had an internal research and development capability for more than twenty years. The Lister Hill National Center for Biomedical Communications has conducted invaluable R&D in biomedical communications since its inception in 1968. Modern technologies and the need to reach out to health professionals present new challenges and opportunities for NLM's R&D programs.

First and foremost, it is critical that the information services that NLM provides be useful to all health professionals engaged in research, education, and, especially, direct patient care. Some of NLM's present services may need to be changed, and new services may be needed to meet the specific needs of health-care practitioners. In order to design future products that utilize the latest information and computer technologies it will be necessary to expand existing intramural research and development programs: a continuous production line is needed.

Based in part on findings from the user studies described in the preceding section, it can be expected that some of these new products may well take on forms and functions markedly different from those presently available to NLM's user community. These may place progressively greater reliance on access to full text information, factual databases, and electronic image libraries--

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16. This study was conducted by Dr. Kevin Fickenscher and his colleagues at the Center for Rural Health Services, Policy, and Research, University of North Dakota, Grand Forks, N.D., February 1989.

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17. President's Commission, *Report to the President*, p. 327.

portions of which may be integrated with such artificial intelligence programs as computer-assisted clinical consultation systems. For example, NLM is developing an image display capability for the online version of McKusick's *Mendelian Inheritance in Man* (MIM) text, so that clinical and radiographic pictures can be combined with text on the user's computer terminal display. A videodisk image library is also an important diagnostic feature of the AI/RHEUM expert system intended for use by the non-rheumatologist clinician.

NLM's current products and services can also serve as the foundation for the development of a new and expansive access initiative. GRATEFUL MED, the microcomputer-based software package that provides an easy-to-use interface to selected databases on NLM's MEDLARS system, should continue to be enhanced. The addition of new and more powerful search capabilities and post-search processing aids that display the most important articles first, or provide cues enabling the user to identify those articles likely to be most relevant, would be beneficial. DOCLINE, NLM's automated interlibrary loan request and referral system, should be linked to GRATEFUL MED so that individual health professionals, not just libraries, may enter a request for a copy of an article into the document delivery system at the time of the GRATEFUL MED search.

New databases likely will be needed. In response to the AIDS crisis, NLM initiated AIDSLINE, which contains more than 13,000 references to scientific articles about AIDS vitally important to the researcher and clinician. AIDSLINE can be accessed through GRATEFUL MED as well as through most computer terminals equipped with modems. It is critical that NLM continue to be responsive to national health concerns in this manner.

Another area of growing national concern is occupational and environmental health. NLM has an active program in toxicology information, evidenced by the TOXNET® system that includes such databases as TOXLINE®, **the Toxicology Data Bank (TDB), and the Hazardous Substance Data Bank (HSDB®)**. In addition to bibliographic citations, the TOXNET files contain scientifically reviewed and edited state of the art textual summaries, along with factual data on acute and chronic toxic effects of more than 90,000

chemicals. There is a need for increased understanding and training on the part of the health professional about occupational or environmental exposure as a causative factor in disease. Linked to this is the need to create even better, more medically focused, information resources. Efficient, reliable access to these full text and numeric databases is needed, especially during emergency situations involving hazardous materials.

Finally, the Panel favors adapting the IAIMS concept to the health-care practitioner not located in a major academic health science center. The IAIMS program is intended to develop a limited number of prototype integrated information systems that can be used by major academic medical centers. It was never targeted to smaller community hospitals, and the individual practitioners they serve. As an independent but parallel activity, NLM should identify a non-university medical site for an experimental implementation of an advanced information access system. This might provide a single point of access for the many forms of information required by the practitioner--laboratory data, hospital admitting data, patient records, and information in data banks and the literature. Thus, new ways to implement the concept of electronic online services to the community-based physician would be explored. The success of such an experiment may ultimately rest on the products of the Unified Medical Language System (UMLS) project, a long-term collaborative research effort by NLM scientists and their colleagues in the medical informatics community. Their goal is to build an increasingly intelligent automated system that understands biomedical terms and their inter-relationships across a variety of machine-readable sources including those found in the biomedical research literature, clinical medicine, and health care administration.

Recommended Action. *NLM should accelerate intramural R&D on products and services that are optimally responsive to the information needs of health professionals by:*

■ *Placing a high priority on research to ascertain the information requirements of U.S. health professionals, the*

suitability of current means for acquiring health-related information, and impediments to such acquisition. Using these data, NLM should mount a national campaign to increase awareness of its information products and services among all health professionals in all settings, and put in place permanent feedback mechanisms to ensure their optimal utility. It is estimated that incremental funding of $2 million is required for this purpose in FY 1990.

■ *Expanding and enhancing existing intramural research and development programs leading to the improvement of current information products and services and the creation of new systems. It is estimated that an increment of $3 million is required in FY 1990 to pursue these objectives successfully.*

Following are the detailed actions that will accomplish this recommendation:

A. Initiate a nationwide baseline survey to establish an overall measure of the extent to which health professionals in specified categories know about, have access to, and use computerized biomedical and health-related databases. The survey should also address such fundamental questions as the reasons for non-use and whether those who use MEDLINE do so directly from NLM or through other means.

B. Target segments of the health professional community, initially medical students, practicing physicians in rural settings, and others unaffiliated with major academic centers, for in-depth study using the focus group technique and/or related means for engaging in close interaction with and direct observation of prospective users of NLM's information products and services. These studies should seek to determine the role that

NLM's information products currently play as these health professionals carry out their daily activities. Findings from these activities also can serve as a valuable aid in the design of new and innovative products to meet those information needs not yet served.

C. Consider the development of an extensive publicity campaign, targeting specific NLM products and categories of prospective user groups. The campaign should consider a number of options such as print media, including notices in medical and health-related journals and direct mailings to physicians' offices; electronic media, including public service announcements, news releases and personal appearances by NLM senior staff on professionally-oriented programming produced for the medical public; and technical demonstrations and exhibits at specialty society meetings. These outreach efforts should be accompanied by imaginative promotional offerings and incentives encouraging trial use and adoption of NLM's diverse array of information management systems. Appropriate criteria for assessing the success of these efforts should be explicitly defined and applied.

D. Establish coalitions and collaborations with governmental, academic, and professional organizations with the objective of encouraging access to, competency in, and the use of computerized database systems as a requirement for credentialling or quality assurance or both. Such relationships could also provide NLM with additional avenues for obtaining advice and feedback to assure the Library that its services are maximally relevant.

E. Accelerate the development of GRATEFUL MED as a convenient and powerful access vehicle for individual users of MEDLARS.

F. Accelerate experimentation with new and novel information products incorporating full-text information, electronic images, and intelligent forms of knowledge representation applicable to the special needs of practicing health professionals, especially those persons located in isolated or rural settings.

G. Expand the scope of DOCLINE by developing the linkages necessary to support implementation of an integrated GRATEFUL MED and document delivery package available to all U.S. health professionals. This integrated package should provide documents directly to health professionals in a timely and cost-effective way. NLM should increase the use of facsimile or other electronic transmission of full-text documents to improve the timeliness of the document delivery system.

H. Develop new database systems containing the latest information required by health professionals in areas of national concern. The rapid development of AIDSLINE and related NLM AIDS information services is an excellent example of NLM's quick response to the Nation's special information services needs.

I. Extend IAIMS concepts to practitioners outside the academic health sciences center. Experiment with the development of a prototype information network within a small- to mid-sized community health care institution.

J. Improve coverage of and focus on occupational and environmental medicine in NLM's toxicology data banks, particularly the Hazardous Substance Data Bank (HSDB); facilitate use of these data banks by physicians, through better access software such as GRATEFUL MED, or through expert systems; join the efforts of other Federal agencies such as the Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Environmental Health Sciences (NIEHS) in increasing awareness and knowledge by physicians about occupational and environmental health issues, and about the available information resources pertaining to these issues.

Recommended Resources. To summarize resource requirements for intramural R&D at NLM:

Incremental Dollars in Millions				
FY 90	FY 91	FY 92	FY 93	FY 94
User Studies				
National survey				
$0.5	$0.6	$0.8	$1.0	$1.1
In-depth studies				
0.5	0.6	0.8	1.0	1.1
Publicity campaign and exhibits				
0.5	0.6	0.8	1.0	1.1
Coalitions and collaboration				
0.5	0.6	0.8	1.0	1.1
Subtotal, User Studies				
$2.0	2.4	3.2	4.0	4.4
New Products and Services				
FY 90	FY 91	FY 92	FY 93	FY 94
Accelerate GM development				
$0.8	$1.0	$1.0	$1.1	$1.3
Full text experimentation				
0.5	0.5	0.5	0.5	0.5
Expand DOCLINE				
0.5	0.8	0.9	1.0	1.2
New databases				
0.3	0.3	0.4	0.4	0.5
Prototype network in community setting				
0.5	0.6	0.6	0.6	0.7
Environmental medicine				
0.4	0.4	0.4	0.4	0.4
Subtotal, New Products and Services				
$3.0	$3.6	$3.8	$4.0	$4.6
Total				
$5.0	**$6.0**	**$7.0**	**$8.0**	**$9.0**
FTEs 10	11	12	13	13

NLM Staffing

The number of FTEs available to carry out the Library's programs has declined steadily over the years and currently is thirty-five below the 1984 level. This combined with the new biotechnology information initiative finds NLM some sixty-five positions below its staffing needs. Nevertheless, NLM staff have performed superbly in accomplishing the Library's national service and research goals, often doing more with less. That trend cannot continue unchecked as demand for NLM basic services continues to grow at a rapid pace. This report recommends significant additional responsibilities and funding for the NLM. It is imperative that NLM obtain additional FTEs if it is to implement effectively the recommendations of this report. Contracting out work can be of some assistance in the service and R&D environment, but fulfilling the additional responsibilities and opportunities identified in this Outreach Plan will require a modest expansion of core NLM staff.

NLM should seek increased staffing levels. These additional FTEs will provide the minimum level of staff support necessary to undertake recommended initiatives as specified. Seventeen FTEs are required in FY 1990 to provide staffing for implementation of this plan's recommendations for improved access in the four specific areas described. This number of FTEs represents the total of those additional personnel that are specified for each of the major recommendations, and does not take into account the other obligations of NLM not reviewed at this time. Specifically, it does not include additional FTEs required for the Congressionally mandated National Center for Biotechnology Information and those needed to respond to the increasing volume of literature and service requests.

Additional NLM Staff Required for New Outreach Activities				
Full Time Equivalents (FTEs)				
FY 90	FY 91	FY 92	FY 93	FY 94
Strengthening RMLs				
3	3	3	3	3
Strengthening Hospital Access to National Sources				
3	3	3	3	3
Training/Fellowships/Demonstration				
1	1	1	1	1
Intramural R&D				
10	11	12	13	13
Total FTEs				
17	**18**	**19**	**20**	**20**

Summary Resource Table

	FY 90	FY 91	FY 92	FY 93	FY 94
			Dollars in Millions		
Individuals and the Regional Medical Library Network					
Assist in connecting health professionals	$1.0	$2.0	$2.2	$2.5	$3.0
Improve capabilities of libraries in network	0.0	1.5	1.6	2.0	2.0
Encourage technology transfer/research	0.0	2.0	2.2	2.5	2.5
Improve network's ability to serve more health professionals	1.0	0.5	0.5	0.5	0.5
Subtotal, RML Network	**$2.0**	**$6.0**	**$6.5**	**$7.5**	**$8.0**
Additional FTEs Required	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**
Strengthening Hospital Access to National Information Sources					
"Access" Resource Grants	$2.0	$3.0	$4.0	$5.0	$6.0
Integrated Academic Information Management Systems					
Phase I/II/III	5.0	6.0	7.0	8.0	9.0
Training	0.5	0.5	0.5	0.5	0.5
Information interchange	0.5	0.5	0.5	0.5	0.5
Subtotal, IAIMS	6.0	7.0	8.0	9.0	10.0
Participation in National Networks	1.0	1.5	2.0	2.5	2.5
Subtotal, Strengthening Hospital Access	**$9.0**	**$11.5**	**$14.0**	**$16.5**	**$18.5**
Additional FTEs Required	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**
Training, Fellowships, and Demonstration Grants					
FIRST and RCDA awards	$1.0	$1.2	$1.4	$1.6	$1.8
Post-doctoral fellowships	1.5	1.8	2.1	2.4	2.7
Increase number of NLM training programs	2.5	3.0	3.5	4.0	4.5
Demonstration Grants	5.0	6.0	7.0	8.0	9.0
Subtotal, Training, Fellowships, Demonstration Grants	**$10.0**	**$12.0**	**$14.0**	**$16.0**	**$18.0**
Additional FTEs Required	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
New Information Products and Services					
User Studies					
National survey	$0.5	$0.6	$0.8	$1.0	$1.1
In-depth studies	0.5	0.6	0.8	1.0	1.1
Publicity campaign and exhibits	0.5	0.6	0.8	1.0	1.1
Coalitions and collaboration	0.5	0.6	0.8	1.0	1.1
Subtotal, User Studies	2.0	2.4	3.2	4.0	4.4
New Products and Services					
Accelerate GM development	$0.8	$1.0	$1.0	$1.1	$1.3
Full text experimentation	0.5	0.5	0.5	0.5	0.5
Expand DOCLINE	0.5	0.8	0.9	1.0	1.2
New databases	0.3	0.3	0.4	0.4	0.5
Prototype network in community setting	0.5	0.6	0.6	0.6	0.7
Environmental medicine	0.4	0.4	0.4	0.4	0.4
Subtotal, New Products and Services	3.0	3.6	3.8	4.0	4.6
Subtotal, New Information Products and Services	**$5.0**	**$6.0**	**$7.0**	**$8.0**	**$9.0**
Additional FTEs Required	**10.0**	**11.0**	**12.0**	**13.0**	**13.0**
TOTAL DOLLARS	**$26.0**	**$35.5**	**$41.5**	**$48.0**	**$53.5**
TOTAL FTEs	**17.0**	**18.0**	**19.0**	**20.0**	**20.0**

Appendix: Outreach Planning Panel Participants

Panel Chair

Michael E. DeBakey, M.D.
Chancellor and Chairman
Department of Surgery
Baylor College of Medicine

Panel Members

Marion J. Ball, Ed.D.
Associate Vice President
Information Resources
University of Maryland at Baltimore

Robert M. Braude, Ph.D.
Assistant Dean for Information Resources
Frances and John Loeb Librarian
Samuel J. Wood Library/C.V. Starr Biomedical
Information Center
Cornell University Medical College

Naomi C. Broering, M.L.S., M.A.
Director, Biomedical Information Resources Center
John Vinton Dahlgren Memorial Library
Georgetown University Medical Center

Roger J. Bulger, M.D.
President
Association of Academic Health Centers

Alison Bunting, M.L.S.
Biomedical Librarian
Louise Darling Biomedical Library
University of California, Los Angeles

Rita Charon, M.D.
Assistant Professor of Medicine
College of Physicians and Surgeons
Columbia University

Theodore Cooper, M.D.
Chairman of the Board
The Upjohn Company

Craig Davis, M.D.
Chief Medical Resident
Salt Lake City Veterans Administration Medical
Center

Lois E. DeBakey, Ph.D.
Professor of Scientific Communication
Baylor College of Medicine

Kevin M. Fickenscher, M.D.
Director
Center for Rural Health Services, Policy and
Research
University of North Dakota

Valerie Florance, M.L.S., M.A.
Assistant Director for Resources
The William H. Welch Medical Library
The Johns Hopkins University

Eloise C. Foster, M.Ln.
Director, AHA Resource Center
American Hospital Association

Sherrilynne A. Fuller, Ph.D.
Director
Health Sciences Library and Information Center
University of Washington

Jay Goldman, Sc.D.
Dean
School of Engineering
University of Alabama at Birmingham

David I. Goldsmith, M.D.
Corporate Medical Director, Product Safety
Surveillance
Sterling Drug, Inc.

Arthur W. Häfner, Ph.D.
Director
Division of Library and Information Management
American Medical Association

Kathleen A. McCormick, Ph.D.
Laboratory of Behavioral Sciences
Gerontology Research Center
National Institute of Aging, NIH

Robert H. Moser, M.D.
Vice President, Medical Affairs
The NutraSweet Company
Adjunct Professor of Medicine, Northwestern
University

Joye Patterson, Ph.D.
Professor Emeritus, School of Journalism
University of Missouri-Columbia

Frankie L. Perry, R.N., M.A.
Director
Communications and Marketing
American College of Healthcare Executives

Paul G. Rogers, LL.D.
Hogan and Hartson
Washington, D.C.

Jerome S. Rubin, LL.B.
Group Vice President, Professional Publishing
Times Mirror Co.

John J. Salley, D.D.S., Ph.D.
Professor of Oral Pathology
Medical College of Virginia
Virginia Commonwealth University

James H. Sammons, M.D.
Executive Vice President
American Medical Association

Lorraine Schulte, M.L.S.
Director
Corporate Technical Library
The Upjohn Company

John F. Sherman, Ph.D.
Executive Vice President
Association of American Medical Colleges

Lawrence Way, M.D.
Professor of Surgery, UCSF
Chief, Surgical Service
San Francisco Veterans Administration Medical
Center

William Lamar Weems, M.D.
Director
Division of Urology
University of Mississippi Medical Center

Edwin C. Whitehead
Chairman
Whitehead Associates

Daniel H. Winship, M.D.
Associate Deputy Chief Medical Director
Department of Medicine and Surgery
Department of Veterans Affairs

Consultants to the Panel

Robert Fisher, M.B.A.
Chairman
Fisher International, Inc.

Donald West King, M.D.
The Richard T. Crane Professor of Pathology
The University of Chicago

Planning Subcommittee, NLM Board of Regents

Edward N. Brandt, Jr., M.D., Ph.D.
Executive Dean
College of Medicine and Health Sciences
University of Oklahoma

Charles N. Brownstein, Ph.D.
Director
Directorate for Computer and Information Science
and Engineering
National Science Foundation

Don E. Detmer, M.D.
Vice President for Health Affairs
University of Virginia

Nina W. Matheson, M.L.
Director
Welsh Medical Library
The Johns Hopkins University School of Medicine

Karen Renninger, M.A., M.L.S.
Chief
Library Division
Department of Veterans Affairs

NLM Staff Resources

Elliot R. Siegel, Ph.D.
Assistant Director for Planning and Evaluation

Susan Buyer Slater, M.A.
Executive Secretary
Deputy Assistant Director for Planning and
Evaluation

Robert B. Mehnert, B.A.
Chief, Office of Inquiries and Publications
Management